DEVELOPMENT OFENVIRONMENT FRIENDLY CLEAN AGENTS FOR REPLACEMENT OF HALONS IN INDIAN COMBAT VEHICLES-TANKS T-72 AND T-90

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ABSTRACT

The research program is to identify alternatives to Halons 1301 in fire extinguishing systems (FES) of Army ground based systems, Combat Vehicles tanks and trucks . Halons are used in crew compartment, hand held and engine compartment of Tanks. Halons have very high ozone depleting potentials and their production was stopped in 1994 in most of the world. As per Montreal protocol use of Halons have been banned. India being developing nation allowed to use Halons up to 2010 for its mission critical Defence applications which has been further extended temporarily. This paper focuses on replacement of Halons from combat vehicle specifically Tanks used by Indian Armed forces. .

Based on the Indian Armed forces requirements, it is decided to study and optimize individual materiel having near equivalent fire extinguishing capability. In this context few concepts have been chosen for this research are 'Heptafluorocarbon' (FE-36, FM-200, etc.) dry powder extinguishant system and AFFF(Aqueous Film Farming Foam) based systemto replace the crew Halon FES.Testing of agents will demonstrate that the ability of FES to extinguish combustion and agents distribution for optimum effectiveness

INTRODUCTION

Halon 1301 has been used for decades as the primary fire extinguishing material for a multitude of military applications. However, Halons have very high ozone depleting potentials and their production was

stopped in 1994 in most of the world.As per Montreal protocol use of Halons have been banned however India being developing nation allowed to use Halons up to 2010 for its mission critical Defenceapplications .Accordingly research on issues affecting combat vehicles, initiated to identify and develop replacement agents and technologies to satisfy the performance requirements of fire protection for combat vehicles used in Indian Army.

Early investigations onHalon Replacement indicated that a universal solution would not be available to the fire protection community for all the systems that used Halon. Hence, multiple agents would probably be required to address the wide range of military applications currently satisfied by Halon 1301. This research will be based on Halon elimination efforts in three separate ground combat vehicle applications: engine compartment fire suppression, crew compartment fire suppression, and hand-held fire extinguishers.

PROBLEM ANALYSIS

Halons are recognized as ideal fire extinguishing agents, particularly for

fighting fires in combat vehicles because they are highly effective in extinguishing fires in minimal time, are non-corrosive and non-toxic, when deployed at recommended volume densities .

Unfortunately, Halons contribute to the depletion of Earth's stratospheric ozone layer, which results in higher levels of ultraviolet radiation at Earth's surface and thus gives rise to serious health effects. Halons are chemically related to chlorofluorocarbons (CFCs) that were earliershown to degrade the ozone layer and consequently were banned.

World over research is going on to find out drop in replacement of Halons but early investigations indicated that a universal solution would not be available. Accordingly it is decided to developnear equivalent clean agent having similar fire extinguishing property.

OBJECTIVES

Objectives of research is to develop environment friendly near equivalent clean agent for replacement of Halons used in Indian combat vehicles tanks T-72 and T-90,as the Halons are banned but still in use for mission critical application by armed forces. Tentative planning of research is given below under head and methodology .

METHODOLOGY

Methodology of research has been divided in three stages which are given as under-

STAGE - I Comprehensive study of near equivalent fire extinguishing agents.

The study will be involved a review of the extensive research and engineering literature covering the physical and chemical processes active in flames and involved in flame extinguishment. Published lists of prospective Halon replacements will be evaluated. Ozone depletion potential (ODP), a useful metric found in regulatory legislation, will be examined in the light of recent work for alternative agents. Also Global warming potential (GWP), a measure of agent effect on climate, will be examined.

STAGE–II: Technical feasibility of agents wrt existing technology in CVs(Combat vehicles).

Technical feasibility of agents wrt existing fire extinguishingsystems and technology in combat vehicles,test methodology, including agent toxicology, storage stability, and extinguishment effectiveness, will be studied. The potential for retro fitmentwrtalternatives on existing platforms will be examined.

STAGE-III: Testingfor fire extinguishingcapability of agents for effectiveness.

Developmental testing of the most promising concepts, by simulating actualhazard area of engine compartment and crew compartment of existingcombat vehicleT-72 ,T-90 etc.Crew Survivability Criteria will be taken in to consideration for the minimum acceptable requirements of automatic fire extinguishing systems for occupied vehicle compartments. These parameters have been established at levels that would not result in incapacitation of the crew member from the fire and its extinguishment, allowing them to take corrective action and potentially to continue their mission.

CONCLUSION

The Indian Army has aggressively pursuing alternatives to Halon 1301 in itsground combat vehicles.As of now, we are reliant on Halons for Engine compartment, crew compartment fire detection and suppression system of our combat vehicles, Tank T-72 and T-90, etc, but the use of Halons have been banned as per Montreal protocol andIndiabeing a developing nation allowed to use Halons in mission critical military

application up to 2010. Accordinglyalternatives of Halon for all three combat vehicle applications to be identified developed and fielded at theearliest. In this regards few concepts like ‘Heptafluorocarbon’ (FE-36, FM-200, etc.) dry powder based extinguishant system and AFFF based systemhave been chosen for this research.

REFERENCES

1. Development of Fire and Suppression Models for DOD Vehicle Compartments: Background, Objectives, and Methodology. .Gritzo, L. A. ; Tucker, J. R. ; Ash, L. ; 1999
2. Evaluation and Testing of Clean Agents for U.S. Army Combat Vehicle Portable Fire Extinguishers. . Moore, T. A. ;Lifke, J. L. ; 1997
3. Evaluation of Alternative Agents for Suppression of Fuel Spray Explosions in Military Vehicle Crew Compartments. .Chattaway, A. ; Dunster, R. G. ; Spring, D. J. ; 1999
4. Fire Suppression Testing of HFC-125, CF3I, and IG-541 for Fire Protection in Engine Compartments of Armoured Vehicles. . Su, J. Z. ; Kim, A. K. ; Liu, Z. G. ; Crampton, G. P. ; Kanabus-Kaminska, M. ; 1998
5. Further Advances in the Development of Hybrid Fire Extinguisher Technology. . Lu, Y. C. ;Wierenga, P. ; 2000
6. Halon Replacement Program for Combat Vehicles: A Status Report. . Bolt, W. ;Herud, C. ; Treanor, T. ; McCormick, S. ; 1997
7. Crew Compartment Alternate Agent Test Program. .Polyanski, S. ; Bolt, W. ; Herud, C. ; 1997

8. U.S. Army Ground Vehicle Crew Compartment Halon Replacement Program. . McCormick, S. ; Clauson, M. S. ; Cross, H. M. S. ; 2000

9. Update on Water as a Three-Dimensional Fire-Extinguishing Agent. .Peregino, P. J., II ; Finnerty, A. E. ; VandeKieft, L. J. ; 1999

10. Metabolism and Pharmacokinetics of Halon 1211 and Its Potential Replacements HCFC-123 and Perfluorohexane. . Brashear, W. T. ; Vinegar, A. ; 1992

11. Advanced Environmentally Friendly Fire Protection Technology. Wierenga, P. ; 2001

12. Assessment of the Fire Suppression Mechanics for HFC-227ea Combined With NaHCO3. . Skaggs, R. R. ; 2002

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